percent by weight, no proportional effect will be obtained. Instead, there would be a decrease in hot forging property and extrudability.

[0023] In consideration of those observations, the third invention alloy is improved in machinability by adding to the Cu-Si-Pb-Zn alloy (first invention alloy) at least one additional element selected from among 1.0 to 3.5 percent, by weight, of aluminum, and 0.02 to 0.25 percent, by weight, of phosphorus.

[0024] Aluminum and phosphorus act to improve machinability by forming a gamma phase or dispersing that phase, and work closely with silicon in promoting the improvement in machinability through the gamma phase. In the third invention alloy to which silicon is added along with aluminum, or phosphorus, thus the addition of silicon is smaller than that in the second invention alloy to which is added bismuth, tellurium, or selenium, which replaces silicon of the first invention in improving machinability. That is, those elements bismuth, tellurium, and selenium contribute to improving the machinability, not acting on the gamma phase but dispersing in the form of grains in the matrix. Even if the addition of silicon is less than 2.0 percent by weight, silicon along with aluminum, or phosphorus will be able to enhance the machinability to an industrially satisfactory level as long as the percentage of silicon is 1.8 or more percent by weight. But even if the addition of silicon is not larger than 4.0 percent by weight, adding aluminum, or phosphorus, together with silicon will saturate the effect of silicon in improving the machinability, when the silicon content exceeds 3.5 percent by weight. For this reason, the addition of silicon is set at 1.8 to 3.5 percent by weight in the third invention alloy. Also, in consideration of the addition amount of silicon and also the addition of aluminum, or phosphorus, the content range of copper in this third invention alloy is slightly raised from the level in the

second invention alloy and copper is properly set at 70 to 80 percent by weight.

[0025] A free-cutting copper alloy also with an excellent easy-to-cut feature which is composed of 70 to 80 percent, by weight, of copper; 1.8 to 3.5 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; at least one element selected from among 1.0 to 3.5 percent, by weight, of aluminum, and 0.02 to 0.25 percent, by weight, of phosphorus; one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium, and 0.02 to 0.4 percent, by weight, of selenium; and the remaining percent, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum and phosphorus in the copper alloy satisfy the relationship $60 \leq X - 3Y + aZ + bW \leq 70$, wherein X is the percent, by weight, of copper, Y is the percent, by weight, of silicon, Z is the percent, by weight, of aluminum, W is the percent, by weight, of phosphorus, a is -2, and b is -3; and the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase. This fourth copper alloy will be hereinafter called the "fourth invention alloy."

[0026] The fourth invention alloy has any one selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium, and 0.02 to 0.4 percent, by weight, of selenium in addition to the components in the third invention alloy. The grounds for mixing those additional elements and setting those amounts to be added are the same as given for the second invention alloy.

[0027] A free-cutting copper alloy with an excellent easy-to-cut feature and with a high corrosion resistance which is composed of 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; at least one element selected from among 0.3 to 3.5 percent, by weight, of tin, 0.02 to 0.25 percent, by weight, of phosphorus, 0.02 to 0.15 percent, by weight, of antimony, and 0.02 to 0.15 percent, by weight, of arsenic, and the remaining percent, by weight, of zinc, wherein the percent by weight of copper, silicon and phosphorous in the copper alloy satisfy the relationship $60 \leq X - 3Y + aZ \leq 70$, wherein X is the percent, by weight, of copper, Y is the percent, by weight, of silicon, Z is the percent, by weight, of phosphorous, and a is -3; and the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase. This fifth copper alloy will be hereinafter called the "fifth invention alloy."

[0028] The fifth invention alloy has, in addition to the first invention alloy, at least one element selected from among 0.02 to 0.25 percent, by weight, of phosphorus, 0.02 to 0.15 percent, by weight, of antimony, and 0.02 to 0.15 percent, by weight, of arsenic. As described above, phosphorus disperses the gamma phase uniformly and at the same time refines the crystal grains in the alpha phase in the matrix, thereby improving the machinability and also the corrosion resistance properties (de-zinc-ification corrosion resistance), forgeability, stress corrosion cracking resistance, and mechanical strength. The fifth invention alloy is thus improved in corrosion resistance and other properties through the action of phosphorus and in machinability mainly by adding silicon. The addition of phosphorus in a very small quantity, that is, 0.02 or more percent by